TESTING AND TEST INSTRUMENTATION IN THE FUTURE

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Introduction

"Speed is life" is a phrase that is increasingly being used to describe the Army's transformation for the future. This phrase applies in describing how our Armed Forces must operate on the battlefield, in describing the mental agility of our future leaders, and in describing how the materiel acquisition process must be streamlined.

In October 1999, Army Chief of Staff GEN Eric K. Shinseki unveiled a vision to make the Army a rapidly deployable, lethal, agile, survivable, and sustainable force. Although the Army is presently capable of full-spectrum dominance, its organization and force structure are not optimized for strategic responsiveness. To address this deficiency, Shinseki launched a major Army transformation effort that initially requires organizing Brigade Combat Teams (BCTs). These teams will function as full-spectrum combat forces capable of deploying to any trouble spot in the world within 96 hours. The BCTs will provide an effective force capable of neutralizing trouble before it escalates into all-out war.

The operational requirements of the BCTs require changes in Army organization, equipment, tactics, techniques, and procedures. The Army thrust is on fielding a BCT capability, not just individual weapon platforms. The Army will field the Interim Armored Vehicle (IAV) as a common baseline capability for each BCT. With slight modification, several families of current medium-based platforms could meet the IAV requirement. Therefore, the Army hopes to select off-the-shelf IAVs from private industry to support an aggressive program schedule. The first Initial Brigade Combat Team is scheduled to achieve initial operating capability by the end of December 2001, supported by the streamlined acquisition of the IAV. This type of accelerated strategy represents the Army's future process for acquiring warfighting capabilities.

Because speed is life, the traditional 10- to 20-year acquisition process for major Defense systems will no longer support the warfighter's ever-changing needs. In concert with these needs, the Army must streamline test and evaluation (T&E) whenever possible to accelerate the materiel acquisition process. Testers must learn to adapt their role and leverage technology to support the accelerated acquisition process.

Is Testing Still Needed?

The need for a significant amount of testing may seem diminished when procuring a nondevelopmental item (NDI) like the IAV. In fact, extensive testing of an NDI might be perceived as an impediment to acquisition streamlining. The vehicles currently under consideration are already mature systems, so why is there a need for much testing? During testing at Aberdeen Test Center (ATC), Aberdeen Proving Ground, MD, less sophisticated, commercially available systems, such as shotguns, forklifts, and dump trucks, have experienced catastrophic failures including ruptured gun barrels, bent axles, and broken wheels. However, in all of these cases, the systems were tested to requirements or conditions above and beyond their original intended capabilities. Testing provided the information needed to identify and correct these performance shortfalls early enough to avoid costly recalls and upgrades of fielded systems.

Testing still plays a critical role in developing high-tech systems as well. One example is the Boeing 777 aircraft, the world's largest twin-engined jet, recognized as the top aeronautical achievement of 1995. During the aircraft's development, customer representatives and component suppliers teamed with Boeing designers and testers. The airplane's various systems were tested together in simulated flight conditions before the first 777 ever flew. Standard certification flight tests were supplemented with 1,000 flight cycles on each airframe-engine combination (for the initial 777-200 models) to demonstrate reliability in simulated operational environments. In addition, engine makers and parts suppliers tested their products extensively to ensure they met airline requirements. This thorough test program was so successful in demonstrating the aircraft's design features that the 777 became the first airplane in history to earn the Federal Aviation Administration's approval to fly extended-range, twin-engined operations at service entry. Obviously, a significant amount of testing was paramount to the 777's success. We can conclude that testing must remain an important component of future system acquisition.

Role Of Tester

To advance streamlined acquisition, the T&E community must support shortened developmental phases, yet continue to adequately assess system performance. To achieve this, testers must leverage their expertise and expand their role as experimenters to become "knowledge brokers." Future testers must become integral parts of the entire acquisition process. They must be involved from concept to combat. The tester's job will no longer be limited to instrumenting systems and conducting experiments. The tester will provide knowledge to the buyer, the user, and the manufacturer throughout the system life cycle. If testers perform their duties correctly, they may actually reduce the number of experiments required to sufficiently evaluate system performance.

The Tester's Tool Kit

By leveraging available technology, the tester can ensure that testing provides meaningful information and is performed correctly the first time. Testers can also determine which parameters must be evaluated through live testing and which parameters can be evaluated by other innovative approaches. For example, the tester can use models to understand the system's physics and use this knowledge to tailor testing. Testers and modelers accomplished this in 1997 at ATC and the U.S. Army Tank-automotive and Armaments Command's Tank Automotive Research, Development and Engineering Center during vulnerability testing of the Wolverine Heavy Assault Bridge. A photograph of the Wolverine under test is shown in

Figure 1. Through the use of finite element analysis modeling, the testers identified the Wolverine's weakest structural locations and targeted vulnerability testing specifically to those areas. Successful results of these tests were used to justify eliminating shots planned on more robust areas of the structure, resulting in significant program cost savings.

Simulation is another tool available to the tester. Testers can use a variety of simulations to reduce the need for live testing. For example, ATC's Firing Impulse Simulator (Figure 2) can be used to test the mechanical and hydraulic components of weapon systems without firing a shot (after the recoil profile of the applicable ammunition is characterized). This simulator allows testers to significantly reduce costs and minimize environmental impact. The money saved on ammunition can be used to increase the number of experiments, which increases confidence in the results.

To minimize cost and schedule duration yet maximize information, future testers must effectively merge simulation and live testing to provide meaningful knowledge.

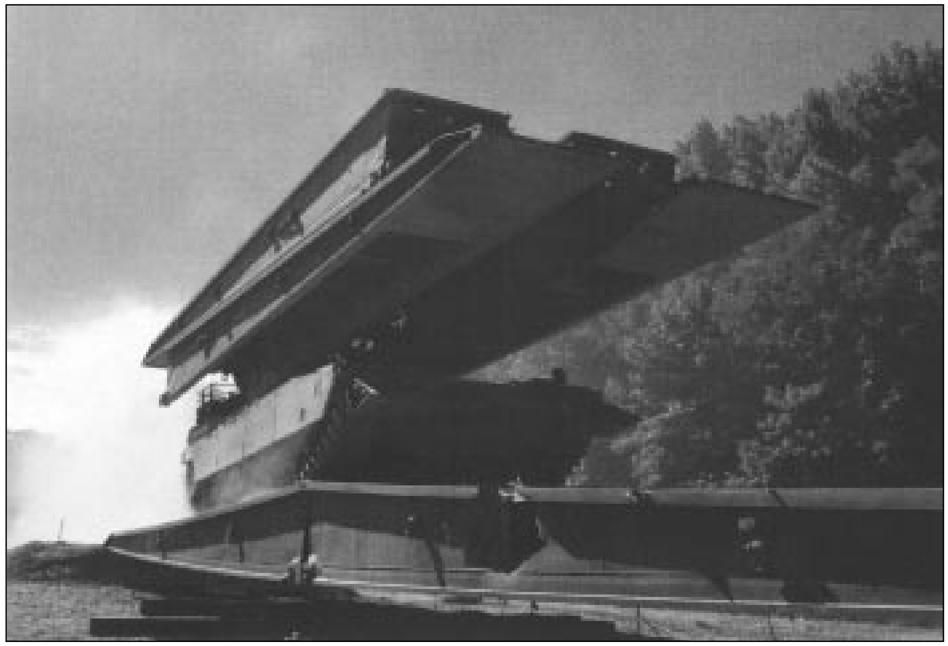

Figure 1.
Wolverine Heavy Assault Bridge undergoing vulnerability testing

Embedded Instrumentation

Other powerful tools that future testers will use include innovative types of data acquisition platforms. Automotive instrumentation will be built-in or embedded into the vehicle system, supporting data collection capability throughout the vehicle's life cycle. When coupled with global wireless transmission, this capability will facilitate real-time data collection, processing, and archiving. These data can be made available to decisionmakers and analysts via the Internet for data mining and manipulation. This concept is illustrated in Figure 3 on Page 32.

Embedded instrumentation can be used to ascertain any fielded vehicle's operational status at any time. System performance can be monitored and recorded not only during developmental testing activities, but also during training missions, operational tests, maintenance activities, and field maneuvers. This valuable information, combined with a high-powered computing capability, supports the ability to make trend predictions based on past performance. Once trends are adequately defined, real-time data collection and transmission on equipment usage and component wear can support just-in-time logistics. For example, the status of an

Figure 2.
155mm self-propelled Howitzer undergoing testing using Firing Impulse Simulator

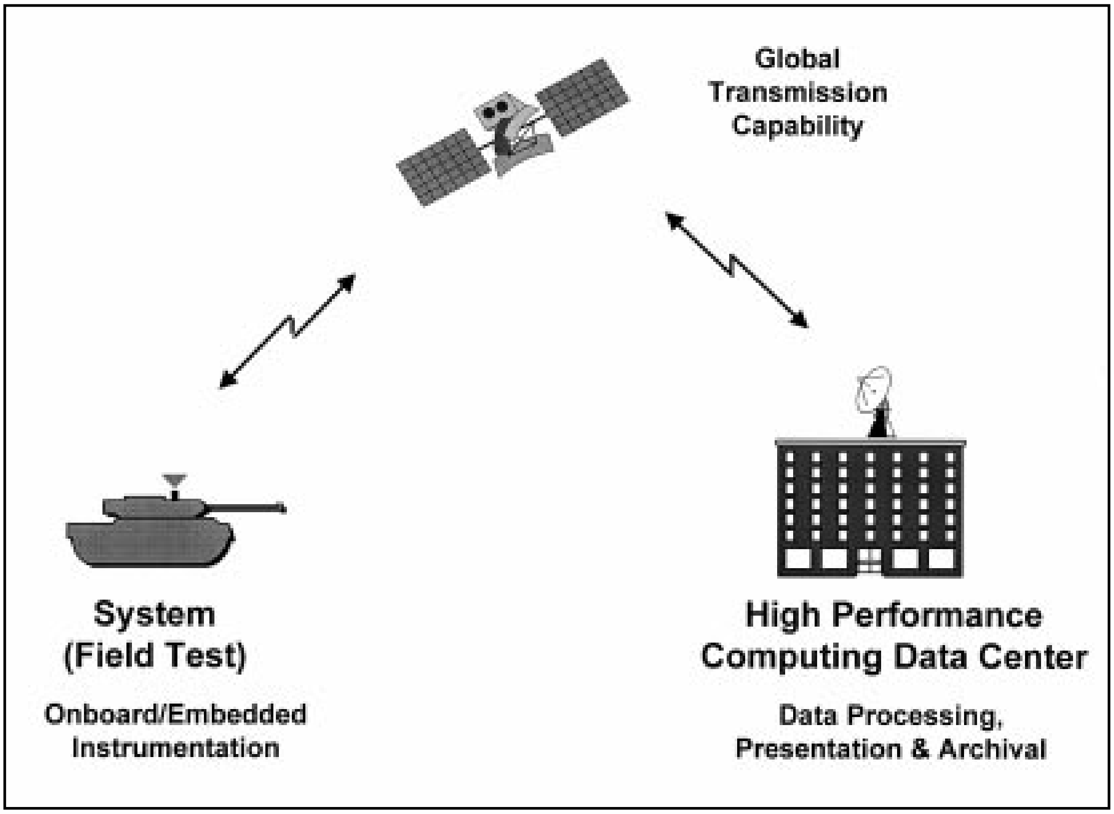

Figure 3.
Data acquisition of the future

individual part can be monitored, and a replacement part can be ordered and transported to the proper unit, thereby facilitating replacement just prior to part failure. This type of maintenance strategy significantly reduces the logistical footprint required to support our in-theater forces. The bottom line is that embedded instrumentation provides total asset visibility throughout a system's life cycle.

Future Test Technologies

Future testing and data acquisition will require pioneering efforts in a broad variety of technology areas. These include modeling and simulation, information technology, high-speed networking and data storage, wireless communications, artificial intelligence, and data security. Advances in instrumentation design are also needed to minimize the size, weight, and power consumption of embedded data acquisition systems.

Space and weight are always precious commodities in a combat vehicle system. Additionally, these same concepts will be applied to man-machine systems like Soldier 2025. Therefore, designers must strive to make instrumentation as close to weightless and invisible as possible. Furthermore, energy needs and operator intervention must be negligible. These challenges make the tester's job exciting and demanding for the next few decades.

Conclusion

The constantly changing needs of the warfighter and the proliferation of accelerated acquisition strategies such as the IAV will require future testers to be flexible and responsive. Testers must provide useful knowledge to the buyer, manufacturer, and warfighter, but must leverage technology to effectively test with less time and money. Developers and testers must continue to ensure that our warfighters have systems that are suitable, effective, and safe but accomplish this at a much faster pace than with earlier systems. While speed is indeed life, the challenge for testers is to keep pace with the velocity of change.

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